



MODEL 700 AND MODEL 721 PHOTOMETERS AND ACCESSORIES



GAMMA SCIENTIFIC, INCORPORATED

ELECTRONIC CIRCUIT FEATURES

The Models 700 and 721, while employing photomultipliers as their sensors, use the latest semiconductor design. As a result, they have the high sensitivity and the excellent stability characteristics of photomultiplier photometers, yet use a minimum of power because of the efficiency of the transistor.

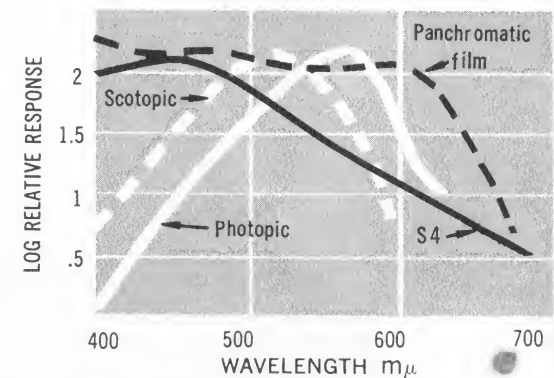
Because of this transistorization of the circuit, they can be operated from standard flashlight batteries. In the 700M and 721M configurations, the self-contained battery power supply gives 400 hours of continuous service before replacement.

Their stability characteristics are excellent for five reasons:

- 1) Extensive use of inverse feedback
- 2) Extremely stable voltage reference
- 3) Careful selection of critical components
- 4) Temperature compensation of critical circuits
- 5) Potting and sealing of high impedance circuits to prevent humidity problems.

Variations in power supply voltage and circuit components are thus effectively minimized.

Warm-up drift is also minimal because of the small thermal masses to be stabilized and low power dissipated as compared with vacuum tube circuits operating photomultipliers.



Some of the spectral responses available.



The Model 700 and 721 are new photomultiplier photometers. They are new in design and performance. They are also new in the concept of their flexibility.

In Design

they employ the latest in field effect transistors, zener references, insulation technology, photomultiplier circuit refinement.

In Performance

they feature fast warm up; low drift; flashlight battery operation in the field; interchangeable AC supply; one tenth percent high voltage regulation; individual testing of photomultiplier tubes for sensitivity, noise, dark current. Complete internal monitoring of battery reference and high voltage. Flexible sensitivity setting. Automatic overload protection of photomultiplier. Instrumentation output. And in addition, the 700 features both logarithmic and linear modes of operation.

In their Conceptual Flexibility

they can be quickly adapted to a tremendous range of light measurement requirements through the use of various Gamma Scientific heads, accessories, and attachments.

As a result, these instruments can measure illuminance (foot candles), luminance (foot lamberts), and radiance (microwatts per steradian). They can measure the light: from extremely small areas (.0001"); from extremely small angles (one minute of arc); in hostile environments; in hard to reach locations.

All of these measurements may be referenced to Gamma Scientific light sources, whose calibration is traceable to the National Bureau of Standards.



Figure 1
MODEL 700 LOG LINEAR PHOTOMETER

The Model 700 offers both a logarithmic and a linear mode of operation. In the logarithmic mode, the Model 700 covers a 4-log range on its meter scale. This 10,000 to 1 range gives the Model 700 great convenience in handling wide variations in light intensity; effectively eliminating groping with a range switch for the right range.

The linear mode offers the higher accuracy and precision of this type of operation. This mode has 3 fixed ranges each a factor of 10 apart (1, 10, 100) and two adjustable ranges that may be used between the other three for greater accuracy, or on either end to extend the range of the instrument both upward and downward in sensitivity.

Furthermore, the log and linear ranges are correlated so that switching between modes is not only practical but, also, a great operational convenience.

The wide selection of ranges, the two modes of operation, and the correlation of modes gives the Model 700 an important part of its versatility.

Adding to this versatility is its capability of making density measurements by using the two density scales on the meter face; one for the log mode and one for the linear mode.

In Figures 1 and 2, the correlation between the log and linear scales is shown. In Fig. 1, the Model 700 is shown with the "Mode" switch in the "Log" position with a meter deflection of "1" on the log scale (the top scale, .1 to 1K). (The "Linear Range" switch has no effect in this position.)

In Fig. 2, with the same light level fed into the 700, the instrument has been switched to the "Linear" mode and the "Linear Range" switch to "1." Now a meter deflection of 100 is obtained on the main linear scale (0 to 120) just below the log scale (.1 to 1K).

Figure 2



MODEL 721, LINEAR PHOTOMETER

The Model 721 Linear Photometer is similar to the 700 except it does not have the logarithmic mode. Instead, it has three linear ranges. Each range has an adjustable sensitivity control which can vary the high voltage on the photomultiplier from 250 to 1250 volts. The three adjustable controls are located in a compartment on the front panel with a cover so that they may be set and then covered.

Its meter scales are shown on the back of the brochure.

The picture above shows the 721M with the compartment cover raised (to the right of the meter). It also shows the photomultiplier upside down in its storage compartment to the left of the meter. Also, the case feature may be seen which allows the top of the case to be removed and hinged to the bottom by means of an extra set of hinge pins. Then with an aluminum spacer that clips into the latches, the instrument can be tipped to an appropriate angle for convenient use; thus solving the problem of what to do with the instrument's lid and at the same time providing an arrangement for convenient use.

Both the 700 and 721 are available in two versions: the 700M or 700L and 721M or 721L. The M and L configurations are identical except for the case. The M version houses the photometer in a Malacca Teak, ruggedized Formica carrying case for portable field use. The 700M is shown on the page to the left in the large photograph. The power supply is at the left of the case. The M features interchangeable battery or 115 volt, 60 cycle AC power supplies.



Here is the L version. It is the laboratory configuration with sloping panel, metal case, and 110 AC regulated supply mounted in the rear.

Each 700 or 721 Photometer is tested and calibrated, with the same 931A photomultiplier that is supplied with the instrument.

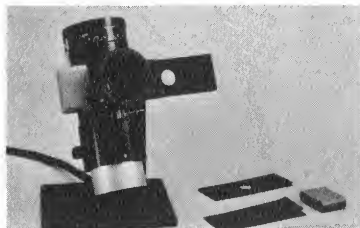
The interchangeable battery and 115 AC power supplies for the 700M and 721M are shown below. The battery supply on the left using standard flashlight battery gives 400 hours of continuous service. All batteries can be tested using the instrument's meter.

The regulated AC supply on the right holds the indicated light value to within $\pm 1/2\%$ for a change from 100 to 130 volts in the AC input.



ACCESSORIES AND ATTACHMENTS

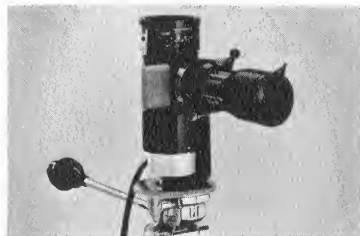
All of the heads, attachments, and accessories shown on this page may be used with any of the Model 700M, 700L, 721L or 721 Photometers. Other accessories will be announced in the future which will further broaden the application of these instruments, thus giving the product line an evolutionary nature.



This is General Purpose Head 700-1 with the photomultiplier inserted. It has a continuously variable 3-log neutral density wedge in the optical path that can be adjusted to provide the desired amount of optical attenuation. The lettered scale at the top of the head allows a particular setting of the attenuator to be repeated at some later time. In addition, color correcting or fixed neutral density filters may be inserted in the optical path by means of the filter carriers shown in the photograph.

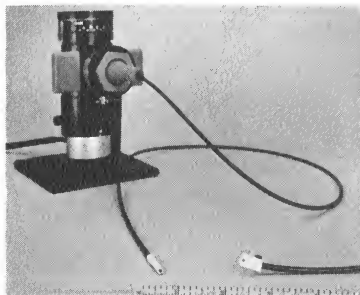


Here the Photometric Telescope (Tele-photometer head) 700-2 is shown. The acceptance angle of the telescope may be readily changed by inserting different apertures in the image plane by means of the knurled cap in the left of the photograph. This accessory comes supplied with $\frac{1}{2}^\circ$, 1° , and 2° aperture plates. Others from 0.2° to 6° are available. Its objective is a 25 mm. diameter f3.0 lens. With a $\frac{1}{2}^\circ$ aperture its maximum sensitivity is better than 10^{-2} foot lamberts full scale. With a 6° aperture it is better than 10^{-4} foot lamberts full scale.



Above, the Photometric Telescope has

been inserted in the General Purpose Head and mounted on tripod. This Telescope has a set of ring sights for aiming the instrument.



Here the General Purpose Head has the Fiber Optics probe 700-3B (light pipe) inserted in it instead of the photometric telescope. This particular probe is 36" long and $\frac{1}{8}$ " in diameter. It has a precision metal tube on its tip for coupling into optical systems. By means of this attachment the measurement of light in spaces normally inaccessible is possible. For instance, with it light measurements inside liquids may readily be made.

Another advantage of the probe is the versatility it gives the photomultiplier in measuring light in difficult environments such as extremes of temperature, in the presence of high radioactivity, in explosive atmospheres, or in high-intensity magnetic or radio frequency fields.

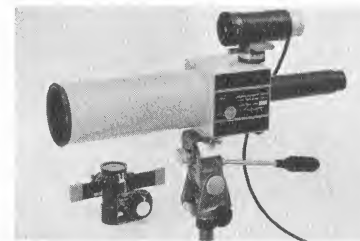
The Miniature Cosine Head 700-8 is shown coupled into a fiber optics probe in the lower right portion of the photograph for measurement of foot candles in small difficult places such as a film gate or inside a complex, enclosed optical system.



This Cosine Receptor Head 700-4 has a carefully designed Lambert surface for footcandle measurement. In addition, it has a 3-position optical attenuator with 0, 2, and 4 logs of attenuation. In the 0-attenuation position, the head makes possible measuring down to 10^{-6} foot-candles. It may be calibrated using the Model 220 standard lamp source with the 220-2 head or the 220-1 head and Calibration Mask 700-9. The head is spectrally corrected to the photopic response of the eye.



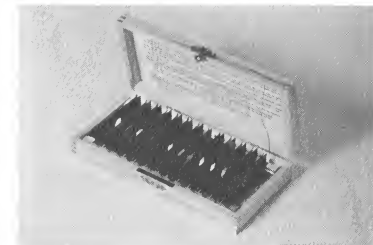
The Monochromator Head 700-5, using a wedge interference filter, makes possible rapid relative spectral analyses. It has a 20 millimicron passband in the 400-700 millimicron region. In the photograph it is shown using the Photometric Telescope Head 700-2. It may also be used with the Fiber Optics Probe 700-3B, if desired. A variable neutral density wedge is included. (See description under 700-1)



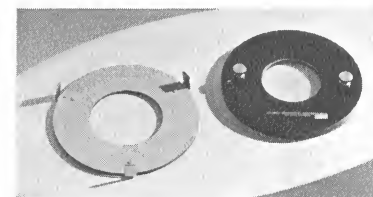
Precision Photometric Telescope 700-16
This telescope has a 60 mm. diameter lens or six times the light gathering area of the Photometric Telescope 700-2. A common objective lens for the Photometer & viewing system lets the operator see exactly the area being measured. It can be supplied with apertures from one minute of arc to 2° . It couples directly into the General Purpose Head 700-1 as shown in the photograph or the Monochromator Head 700-5 in the lower left.



Scale Expander Model 700-20
This self-powered attachment plugs into the output jack of either the 700 or 721 and allows any portion of the meter scale to be expanded on its own self-contained meter, at the same time the meter in the photometer is displaying the overall signal level. Full scale expansion of 10, 5, and $2\frac{1}{2}\%$ is available. In the maximum expansion position, each small division corresponds to .1%.



A matched set of filters is available for inserting fixed attenuation in the General Purpose Photomultiplier housing 700-1. These filters are calibrated by using Gamma Scientific's photometric bench. Values available are .5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, and 4.0 logs.

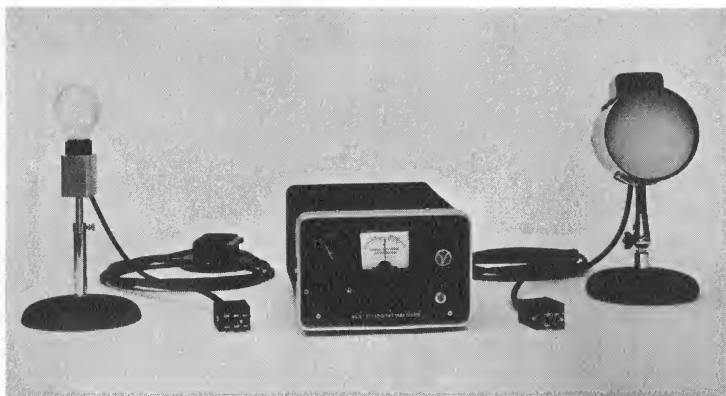


Calibration Mask 700-9 and CRT Filter
The attachment on the left is a mask that fits over the Model 220-1 foot lambert head to allow the Cosine Receptor 700-4 to be calibrated against it in terms of foot candles. The filter on the right modifies the spectral output of the 220-1 head so that it closely simulates the spectral energy distribution of a P-11 Cathode Ray Tube phosphor. Other CRT Filters available.



Portable Calibrator Model 201
This self-contained battery operated calibrator has a tungsten bulb and a diffusing system for producing a luminous surface of known luminance. The large control varies the output in discreet levels from 31 to 0.1 foot lamberts. The voltage on the bulb is standardized by using the meter in either the Model 700 or 721 Photometer to which it may be connected with a plug-in cable. This calibrator may be used to standardize a Fiber Optics Probe 700-3B or the Photometric Microscope 700-10.

CALIBRATION EQUIPMENT



The Model 220 Standard Lamp Source with an appropriate head may be used as an absolute reference to calibrate either the Model 700 or the Model 721 with any of the attachments shown in this brochure. The 220 may also be used to calibrate any other photometer, telephotometer, or foot candle meter. This calibration is traceable to the National Bureau of Standards and can be supplied in either photometric or radiometric terms.

The Model 220 contains a highly regulated DC power supply designed specifically for operating standardized lamps supplied by Gamma Scientific as candle power and luminance references.

In addition to the regulated supply, the Model 220 contains a potentiometric circuit for standardizing the current thru these lamps against the voltage of a Weston-type unsaturated cadmium standard cell. The long term stability of the standard cell is one part in a thousand for temperatures between 10°C and 40°C.

The precision of the standardization is also better than one part per thousand as indicated by the transistorized electronic galvanometer.

The plug on the front panel allows any one of a number of different heads to be operated from the source. Shown above on the right is the Luminance Standard Head Model 220-1 producing 100 footlamberts of Illuminant A. On the left is the Standard of Horizontal Candle Power Model 220-2 (approx. 35 candle power). The accuracy of the calibration is $\pm 2\%$ for the 50 hour life of the lamps. Other luminances on special order.

Each head is individually calibrated; each has an elapsed time indicator and each has a precision resistor current monitor.

Either head may be readily mounted on a tripod or on an optical bench by means of its standard fittings.

PHOTOMETRIC MICROSCOPE

The Model 700-10 Photometric Microscope consists of a high-quality microscope with X, Y, and Z adjustments for accurately positioning and focusing the instrument with regard to a surface.

It can measure the light from an area as small as .0001" dia. By using different objectives and eyepieces shown in the photograph, larger areas and higher sensitivities may be obtained. Distance from the surface can be varied from .004" to 2 1/4" depending on magnification of the objective.

It is an excellent device for analyzing the light output of electronic display devices such as cathode ray tubes, electroluminescent panels and neon display indicators.

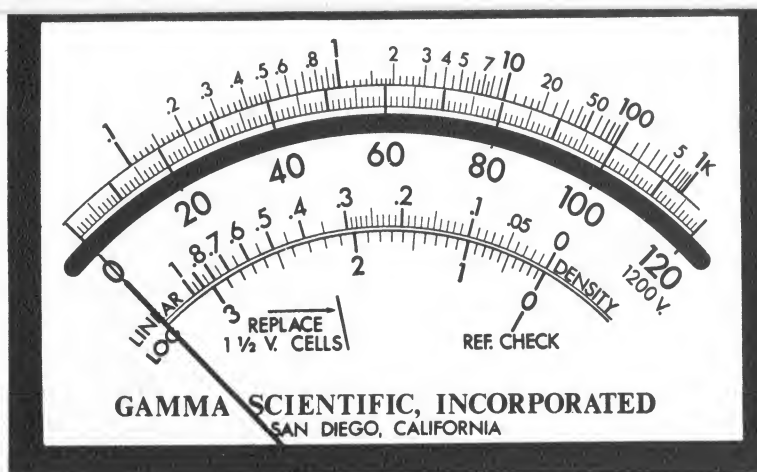
The instrument is also ideal for measuring the reflectance or density of small areas, when used with appropriate external light sources.

In the center of the image plane of the microscope objective, a small fiber optic probe picks up the light from the area to be measured and feeds it to either the 700 or 721 Photometer. The coupling is accomplished by means of either the Microscope to General Purpose Head Adaptor 700-11, or the Fiber Optics Probe 700-3B.

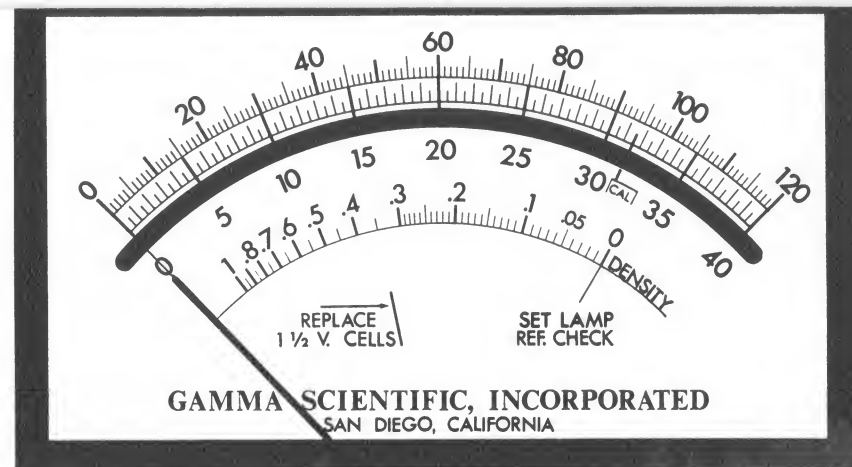
A scanning micrometer eyepiece 700-10-25 is available which allows the pick-up fiber to be moved in measurable increments of 0.1 mm. across the image plane of the objective. It can be supplied with an electrical position transducer.

Shown in the illustration is a high-stability stand designed for maximum versatility of adjustment. With this stand the microscope head may be adjusted to any height, tipped at any angle, and traversed in any plane.





Model 700 METER SCALE
(75% Size)



Model 721 METER SCALE
(75% Size)

TECHNICAL SPECIFICATIONS

MODEL 700L AND 700M LOG LINEAR PHOTOMETER

- MAXIMUM SENSITIVITY:** (a) DC amplifier sensitivity greater than 7.5 nanoamps for full scale deflection.
(b) Maximum Photomultiplier high voltage more than 1250 volts.
- PHOTOMULTIPLIER:** 931A or any other 11-pin interchangeable type. Other photomultipliers with different number of stages and/or requiring higher voltage can be accommodated by special order.
- METER SCALES:** One log range: 1 to 10,000
One linear range: 0 to 120
Two density scales: one 3.0 to 0, one 1.0 to 0.
- LINEARITY, LINEAR MODE:** Better than $\pm 2\%$ of full scale
- LINEARITY, LOGARITHMIC MODE:** $\pm .05$ log for middle two logs
 $\pm .1$ log for middle three logs
- LOGARITHMIC-LINEAR CORRELATION:** Same as Linearity, Log Mode
- METER ACCURACY:** $\pm 1\%$ of full scale, $5\frac{1}{2}$ " meter movement with mirrored scale.
- ELECTRICAL SENSITIVITY CONTROLS:** Logarithmic Mode, one fixed range. Linear Mode, five ranges, three of which are fixed so that their full scale value correlates with the 1, 10, 100 scale calibrations of the logarithmic mode. Two additional adjustable ranges that may be set using Linear Sensitivity Control which varies the photomultiplier high voltage from 250 to 1,250 volts.
- OUTPUT JACK:** On front panel to drive chart recorder (6000 ohm input impedance or greater) or digital voltmeter 100 mv. full scale
- SIZE:** 700M 16" x 6" x 9"
700L $9\frac{1}{2}$ " x 10" x $6\frac{1}{2}$ "
- WEIGHT:** 700M 14 lbs. with batteries, in ruggedized Formica case, Malacca Teak finish.
700L $7\frac{1}{2}$ lbs.
- POWER:** Self contained battery pack or interchangeable 115 volt, 60 cycle, AC regulated power supply.
- OPERATING TEMPERATURE:** 40° to 120°F.

MODEL 721M AND 721L LINEAR PHOTOMETER

- MAXIMUM SENSITIVITY:** (a) DC amplifier sensitivity greater than 7.5 nanoamps for full scale deflection.
(b) Maximum Photomultiplier high voltage more than 1250 volts.
- PHOTOMULTIPLIER:** 931A or any other 11-pin interchangeable type. Other photomultipliers with different number of stages and/or requiring higher voltage can be accommodated by special order.
- LINEARITY:** Better than $\pm 2\%$ of full scale.
- METER ACCURACY:** $\pm 1\%$ of full scale, $5\frac{1}{2}$ " meter movement with mirrored scale.
- SENSITIVITY CONTROL:** Three ranges selectable by front panel range switch. Each range is independent of the others and may be adjusted by means of its individual photomultiplier high voltage control available under lid on front panel. High voltage adjustment range from less than 260 V to greater than 1250 V.
- OUTPUT JACK:** On front panel to drive chart recorder (6000 ohm input impedance or greater) or digital voltmeter 100 mv. full scale.
- METER SCALES:** 0 to 120
0 to 40
1.0 to 0 Density
- SIZE:** 721M 16" x 6" x 9"
721L $9\frac{1}{2}$ " x 10" x $6\frac{1}{2}$ "
- WEIGHT:** 721M 14 lbs. with batteries, in ruggedized Formica case, Malacca Teak finish.
721L $7\frac{1}{2}$ lbs.
- POWER:** Self-contained battery pack or interchangeable 115 volt, 60 cycle, AC regulated power supply.
- OPERATING TEMPERATURE:** 40° to 120°F.

Specifications subject to change without notice.



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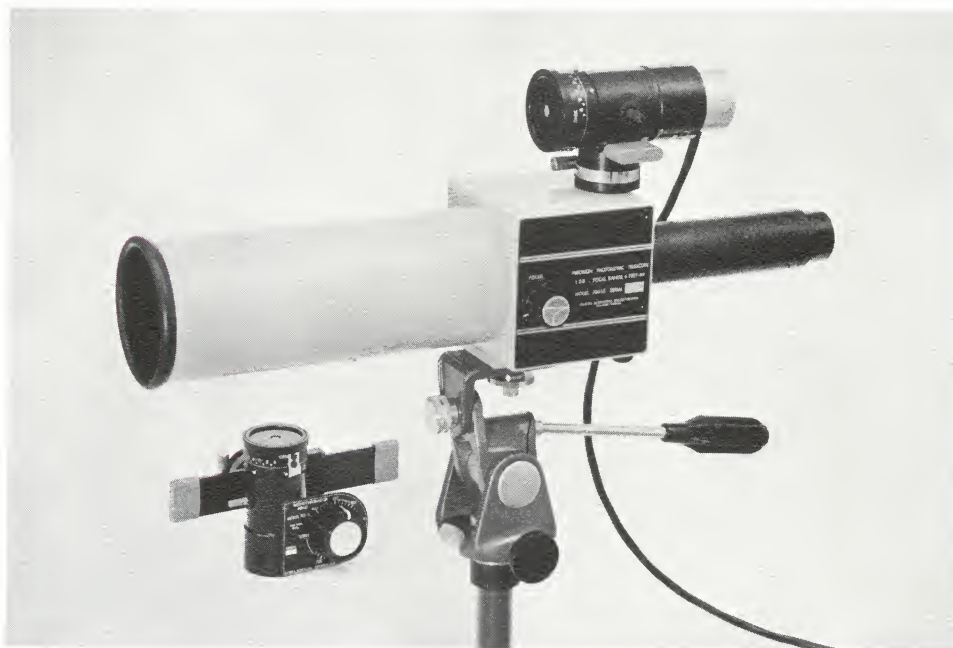
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DATA SHEET

GAMMA SCIENTIFIC, INCORPORATED

Preliminary Data Sheet #370



MODEL 700-16 PRECISION PHOTOMETRIC TELESCOPE

The Model 700-16 is a Photometric Telescope featuring high resolution (smallest aperture - 1 minute of arc) and good light gathering power (down to 10^{-5} footlamberts with a 2° aperture). When coupled to Gamma Scientific's Model 700 or 721 Photometers, the combination becomes either a telephotometer or a tele-spectroradiometer, depending on the selection of either of two photomultiplier housings available from Gamma Scientific.

In the objective's image plane, the end of a single glass fiber located in the center of the field acts as the aperture. The fiber is bent through a 90° arc bringing the energy from center of the image plane to the top of the telescope. Here a coupling ring connects to either the General Purpose Housing, Model 700-1, (shown on the telescope in the picture) or the Monochromator Housing, Model 700-5 (in the lower left).

The viewfinder provides an erect image of the field of view with the fiber shown in positive registration with the field. As a result, the presentation allows exact determination of the area being measured.

The optical system has very low flare, as the only optical elements in the photometer section are the achromatic objective and the pick-up fiber. Also, the Telescope will measure polarized light accurately because it has no partial reflecting surfaces; and, as a result, will measure reflected glare without polarization error.

The Telescope design includes an external flare shield to reduce light entering the system from outside the Telescope's field of view. It has a fully compensated focusing system which holds the photometric sensitivity constant over the focusable range of the Telescope.

TECHNICAL SPECIFICATIONS

OBJECTIVE: 60 mm. diam. x 180 mm. focal length

APERTURES AVAILABLE: 1 or 3 minutes of arc, fixed (factory changeable)

6, 12, 30 minutes, 1 and 2 degrees of arc (interchangeable in field)

MAXIMUM SENSITIVITY WITH 2° APERTURE: 10^{-4} footlamberts full scale with either Gamma Scientific Model 700 or 721 Photometers. Higher sensitivities available on special order.

FOCUSING RANGE: 6 ft. to infinity

OUTPUT: Couples directly into Gamma Scientific 700-1 General Purpose Photomultiplier Housing or 700-5 Monochromator Housing

VISUAL MAGNIFICATION: 8 power

VIEWFINDER: Erect image

MOUNTING: 1/4-20 standard tripod

LENGTH: 22 inches

WIDTH: 4 inches

HEIGHT: 4-3/4 inches (without head)

WEIGHT: 4 lbs.

FINISH: Gray epoxy paint



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MODEL 2000 TELEPHOTOMETER

The Model 2000 Telephotometer is a new high resolution, high sensitivity instrument for measuring the luminance of a surface. It features a transistorized design, an extremely wide range of apertures, interchangeable lenses, a built-in, high-stability calibrating source, and an integral range computer.

The transistorized design allows the electronics to be operated from a flashlight battery power supply for field use. An interchangeable regulated AC supply is also available.

Apertures from 2 minutes of arc to 3 degrees are instantly selectable from the control panel by means of a rotatable turret.

The interchangeability of lenses allows the optimum lens to be selected for a particular measurement. Long focal length telescopic lenses as well as microscope objectives can be readily accommodated.

The internal calibrated source is a seasoned sub-miniature tungsten lamp. Its voltage can be standardized to better than .2 percent by means of an internal potentiometric circuit.

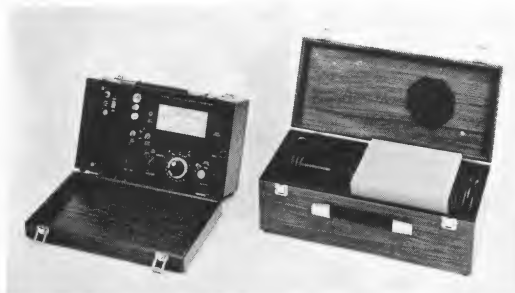
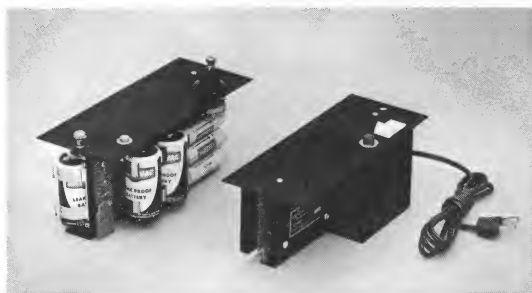
The range computer is an integral part of the 7-step electrical sensitivity control. Once the aperture size and the neutral density filter factors are fed into the computer, the full-scale sensitivity of the instrument for any setting of the electrical sensitivity control is shown directly.



On the extreme left, the rear panel of the Optical Head is shown. All operating controls, including focus, are on this panel. The Control Unit on the right is housed in a separate case with the 5" taut band mirrored meter and the range computer described above.



Features of the Model 2000: On the right, standard 2 x 2-inch glass interference or neutral density filters may be readily inserted in the optical system behind the aperture. In the middle, lens interchangeability. The lens being inserted is a standard microscope objective. On the left, a close-up shows the integral footlambert computer built into the main 7-step electrical sensitivity control.



On the Left: The Model 2000 can be supplied with either or both the battery power supply on the left or the interchangeable regulated supply on the right. In the Right Picture: The instrument comes complete in two matching ruggedized formica carrying cases with gasketed lids. The control unit on the left; the optical head, power cable, flare shield and alternate objective lenses store in the right case.

TECHNICAL SPECIFICATIONS

ACCURACY: $\pm 4\%$ of full scale
APERTURES: 2, 6, 20-minute, 1° and 3° selectable from panel
MAXIMUM FULL-SCALE SENSITIVITY: 3×10^{-5} footlamberts
FILTER WHEEL: 8 position supplied with calibrated 1, 2, 3, 4-log neutral density filters
FOCUS: From rear panel, 4 feet to infinity with standard 200 mm lens
CALIBRATION: By means of sub-miniature Mil Spec Tungsten lamp. Internal potentiometric circuit standardizes voltage to lamp to $\pm 0.2\%$
EYEPIECE: Erect Image: Variable magnification 3 to 1.
TELESCOPE POWER, VISUAL: With 200 mm objective from 5 to 15 power

OBJECTIVE LENS INTERCHANGEABILITY: By means of bayonet base on objective mounting tube
SPECTRAL RESPONSE: S11 photosurface-photopic correction filter supplied
POWER: Either regulated 100-125 volts AC, 60 cycle supply or interchangeable battery pack using standard flashlight batteries and mercury reference cells
ILLUMINATION: Built in for meter scale and main sensitivity control
OUTPUT JACK: 100 mv output on front panel for chart recorder or digital voltmeter
SIZES: Control Unit - $16'' \times 9\frac{1}{2}'' \times 5\frac{3}{4}''$
 Optical Head - $5'' \times 7\frac{1}{2}'' \times 15''$
WEIGHT: Control Unit with batteries -14 lbs.
 Optical Head - 7 lbs.

PRICE: Model 2000 complete with 2 matched carrying cases and 200 mm objective, but less power supply - \$2,860.00
 Battery power supply - \$90.00 Regulated AC power supply - \$90.00



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MODEL 700-10 PHOTOMETRIC MICROSCOPE

The 700-10 Photometric Microscope consists of a high-quality microscope with X, Y, and Z adjustments for accurately positioning and focusing the instrument with regard to a surface.

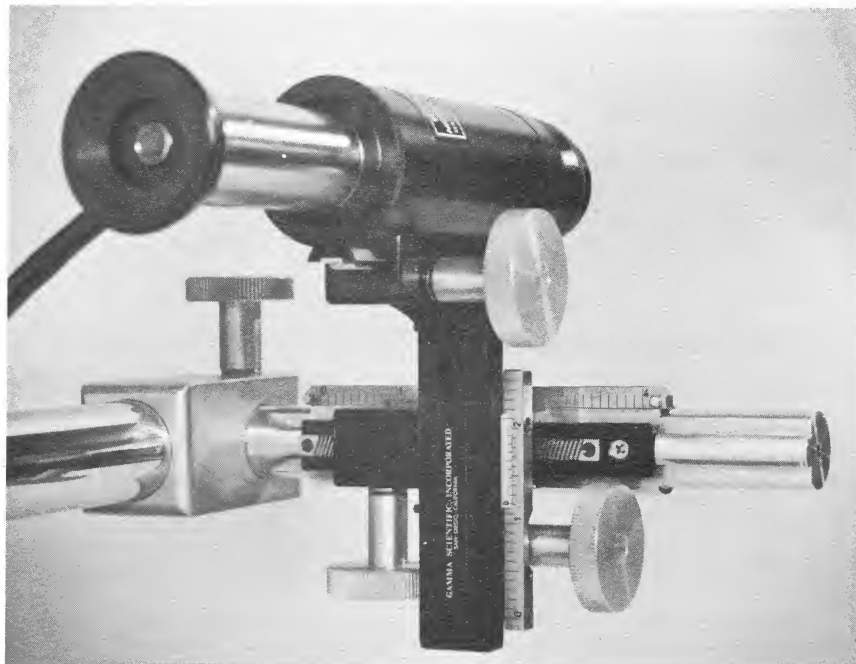
In the center of the microscope field a small fiber optics probe picks up and feeds the light from the area to be measured into an external fiber optics light pipe for coupling into the Gamma Scientific Model 700 Log Linear Photometer or the Model 721 Linear Photometer.

The light from an area as small as .0001" can be measured. By using different objectives and eyepieces shown in the photograph, larger areas and higher sensitivities may be obtained. Distance from the surface can be varied from .004" to 2-1/4" depending on the magnification of the objective.

The instrument is ideal for measuring the reflectance of small areas. It can also measure the density of small areas of film when used with an appropriate external light source.

It is an excellent device for analyzing the spot size and brightness of electronic display devices such as cathode ray tubes, and alpha numeric readouts of all types.

Shown in the illustration is a high-stability stand designed for maximum versatility of adjustment. With this stand the microscope head may be adjusted at any angle and traversed in any plane. Its range of adjustment can provide an offset of up to 16" from the center of the heavy cast iron base. Vertical range of adjustment is greater than 18".



The photograph shows a close view of the microscope and its positioning mechanism. To provide a maximum of convenience in positioning the microscope and measuring the brightness of any specific area, X and Y position adjustment is provided by the two lower knobs. In one direction there is 3.2 inches of travel and in the other 1.8 inches. Vernier scales are included to read distances to the nearest .01 inch. A filar micrometer attachment is available to move the probe in measurable .01 mm increments in the image plane.

The output of the microscope couples either into a standard Gamma Scientific Fiber Optics Probe 700-10-3B shown in the photographs or directly into the General Purpose Housing 700-1 by means of a simple adaptor.

Here the microscope is shown in the horizontal position, as it might be used in measuring cathode ray tube spot size and light output.

Applications:

- Cathode ray tube light measurement
- Electronic digital display device light measurement
- Microdensitometry (with suitable light source)
- Microreflectometry (with suitable light source)
- Microfluorescence light measurement
- Microphotographic light measurement
- Optical bench image analysis

Technical Specifications

MEASUREMENT AREA: From less than .0001" diameter to greater than .160".

SENSITIVITY: With a .01" measurement area and a lens with a N.A. of .25, a full scale sensitivity of 1 footlambert can be achieved with both Model 700 and 721 Photometers. Higher sensitivities may be achieved thru using a selected photomultiplier.

OBJECTIVE POWER: X2.5, X4, X10, X20, X100 (oil immersion).

FREE WORKING DISTANCE: .004 to 2.25 inches. (dependent upon objective)

FOCUSING MOVEMENT: 2-3/4 inches.

X MOVEMENT: 3.20 inches.

Y MOVEMENT: 1.80 inches.

STAND ADJUSTMENTS:

Vertical, 18 inches.

Offset, up to 16 inches.

Rotatable, about 4 axes

BASE WEIGHT: 20 Pounds.



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GAMMA SCIENTIFIC, INCORPORATED
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San Diego, California 92120
(714) 282-2178

Data Sheet #372 D

February 1, 1966

LENS INFORMATION
FOR
GAMMA SCIENTIFIC PHOTOMETRIC MICROSCOPE 700-10

TABLE 1
Table of Measurement Diameters
for Various Objective-Pick-up Aperture Combinations

Objective Part No.	Objective Power	Pick-up .002"	Aperture .006"	Diameter (Fiber Diameter) .012"	.027"	.060"
700-10-4	2.5	.0008"	.0025"	.0048"	.011"	.024"
700-10-5	2.5	.0008	.0025	.0048	.011	.024
700-10-6	4	.0005	.0015	.003	.007	.015
700-10-11	5	.0004	.0012	.0024	.0055	.012
700-10-7	10	.0002	.0006	.0012	.0027	.006
700-10-12	15	.00013	.0004	.0008	.0018	.004
700-10-10	20	.0001	.0003	.0006	.0013	.003
700-10-8	40	.00005	.00015	.0003	.0007	.0015
700-10-9	100	.00002	.00006	.00012	.00027	.0006

Table 2
Microscope Objective Information

Gamma Scientific Part No.	Power	Numerical Aperture	Free Working Distance (Lens to work)
700-10-4	2.5	.03-.25*	2 1/4"
700-10-5	2.5	.1	2 1/4"
700-10-6	4	.1	3/4"
700-10-7	10	.25	1/4"
700-10-8	40	.65	.02"
700-10-9 oil immersion	100	1.25	.1 mm
700-10-10	20	.40	.20
700-10-11	5	.18	3/4"
700-10-12 Cassegrain Reflector for UV & IR	15	.28	1"

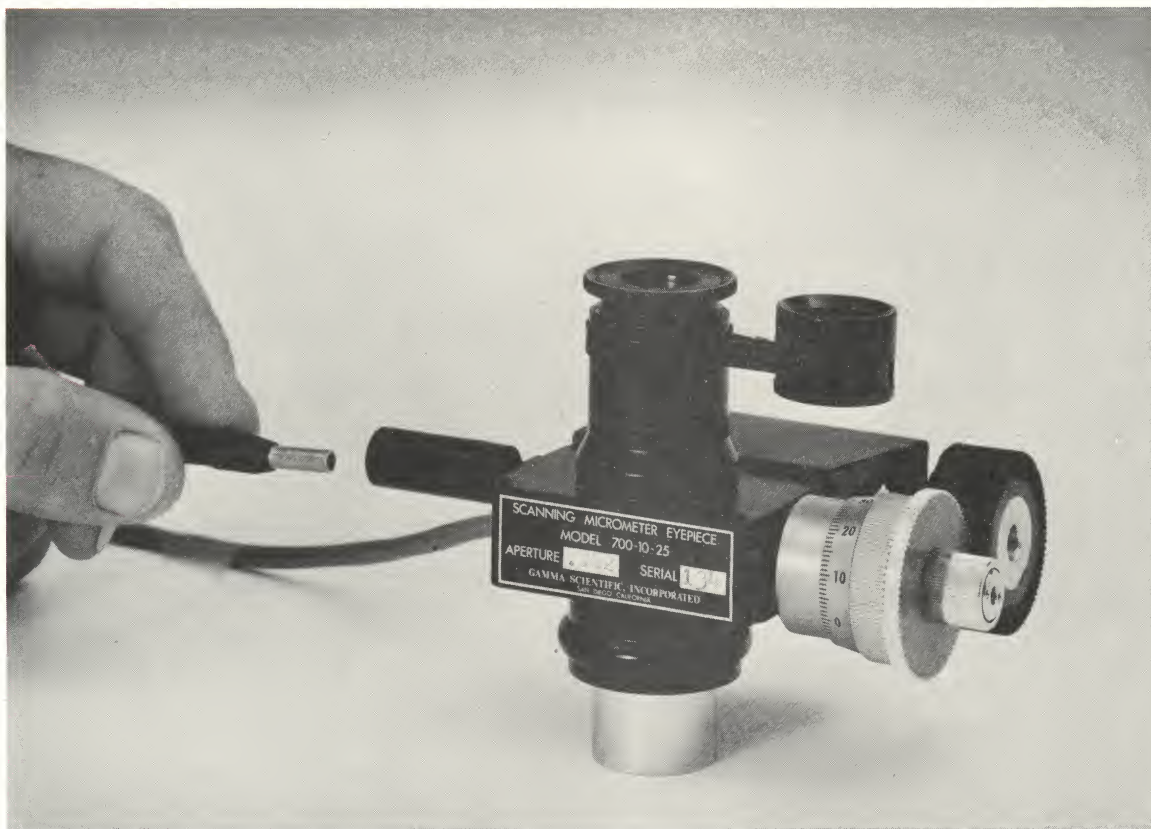
(*) Aperture variable from .03 to .25 in 7 steps; also includes removable flare shield.

Definition and Calculation of Sensitivity

The maximum sensitivity of the Photometric Microscope system is defined as follows: With a measurement dia. of .01" and an objective having a numerical aperture of .25, a full scale reading from a 1 footlambert surface can be achieved with either the Gamma Scientific Model 700 or 721 Photometers. Higher sensitivities are possible by removing the photopic correction filter and/or using selected photomultipliers.

To calculate the maximum full scale sensitivity of the system with a different objective and/or aperture, (1) select the measurement diameter desired from Table 1, (2) select the numerical aperture (N.A.) of the objective from Table 2, (3) then use this formula:

The new resultant
full scale sensitivity of the system = .1 footlambert $\times \left(\frac{.25}{\text{N.A.}} \right)^2 \times \left(\frac{.01}{\text{measurement dia. in inches}} \right)^2$



700-10-25 SCANNING MICROMETER EYEPIECE

This eyepiece fits the Gamma Scientific Model 700-10 Photometric Microscope. It may be used interchangeably with the standard microscope eyepiece, 700-10-35. The 700-10-25 contains a micrometer stage that moves the pick-up probe in the image plane in small, measurable increments (.01 millimeter). This capability allows the pick-up probe to be scanned across the microscope's field, thus making possible detailed luminance profiles.

Pick-up probe size can be from .002" to .04" diameter. The actual measurement diameter is then determined by dividing the power of the objective into the probe diameter.

The standard Gamma Scientific Model 700-3B Fiber Optics Probe couples into the eyepiece as shown in the photograph, and in turn, it may be coupled either into the General Purpose Housing, 700-1, or the Monochromator Housing, 700-5. An optional attachment also shown in the photograph is the Electrical Position Transducer, 700-10-25-1, geared directly to the Micrometer Head. This transducer is a precision 10-turn potentiometer. When a stable voltage is applied across it, the voltage from its tap is directly proportional to the position of the fiber in the field. This signal may be fed to one axis of a chart recorder. The other axis may be driven from the photometer output jack on the front panel of the Model 700 or the Model 721 Photometer, thus giving the capability of making an X Y plot of luminance versus distance.



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5841 MISSION GORGE ROAD, SAN DIEGO 20, CALIFORNIA / PHONE 282-2178



MODEL 220 STANDARD LAMP SOURCE WITH LUMINANCE STANDARD AND CANDLE POWER HEADS

The Model 220 Standard Lamp Source is a highly regulated D.C. power supply designed specifically for operating standardized lamps supplied by Gamma Scientific as candlepower and luminance references. The calibration of these lamps is traceable to the National Bureau of Standards.

In addition to the regulated supply, the Model 220 contains a potentiometer for standardizing the current thru these lamps against a Weston type unsaturated cadmium standard cell. The long term stability of the standard cell is one part in a thousand for temperatures between 10°C and 40°C.

The precision of the standardization is also better than one part per thousand as indicated by the transistorized electronic galvanometer.

The plug on the front panel allows any one of a number of different lamps to be operated from the source. Shown above on the right is the Luminance Standard head producing 100 footlamberts of Illuminant A. On the left is the standard of horizontal candle power (approx. 35 candlepower).

Each of these is individually calibrated, each has an elapsed time indicator and each has a precision resistor current monitor.

The candle power standard may be mounted on an optical bench by means of its Gaertner mounting rod.

The Luminance Standard Head may be mounted on a tripod by means of its 1/4 - 20" threaded socket.

TECHNICAL SPECIFICATIONS

SENSITIVITY OF ELECTRONIC GALVANOMETER: .1% per division of current thru bulb.

VOLTAGE REFERENCE: Weston type unsaturated cadmium standard cell.

CONTROLS: Off-Standby-On

Lamp Intensity Adjustment

Null Amp. Zero Set

Set Zero Push Button

POWER INPUT: 100 watts, 105 to 120 volts AC, 60 cycle

SIZE: 8" wide X 5" high X 12" deep

WEIGHT: 8 lbs.

LUMINANCE STANDARD HEAD

100 Ft. Lamberts $\pm 2\%$

2854° $\pm 50^\circ$ (Illuminant A)

Size of Luminous Surface 4 1/4" Dia.

Luminance Uniformity $\pm 1 \frac{1}{2}\%$ on a
circle centered on the luminous
surface 3" in diameter

Life: 50 hours

CANDLE POWER HEAD

35 horizontal candle power

2600° K $\pm 50^\circ$ K

Accuracy $\pm 2\%$ of specified
value in specified
direction

Life: 50 hours



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Dear Sir:

We are enclosing the information you requested on our photometric instruments.

Accurate light measurement is Gamma Scientific's only business. Our calibration facilities are traceable to the National Bureau of Standards.

All of our designs are based on current solid state technology and, in addition, offer great flexibility and operating convenience.

All of our products are fully warranted for a one year period and all are sold on a 30 day approval basis.

If you have a light measurement problem, we would encourage you to call our Sales Engineering Department collect. In turn, we will be glad to describe which of our instruments could be best applied, in what manner, and indicate what factors would influence the accuracy of measurement and to what degree.

Sincerely,

GAMMA SCIENTIFIC, INC.

A handwritten signature in dark ink, appearing to read 'Harold P. Field'. The signature is written in a cursive, flowing style.

Harold P. Field
President

HPF:sd
Encl.

GAMMA SCIENTIFIC, INCORPORATED
San Diego, California

Partial List of Customers

American Broadcasting Company	United States Air Force
Ampex Corporation	Hanscom Field, Mass.
Argonne National Laboratory	Lowry Air Force Base
Autonetics Div., North American Aviation	United States Army
Bell Telephone Laboratories	Army Pictorial Center, Brooklyn
Bendix Corporation	USAECOM, Fort Monmouth, N. J.
British Broadcasting Company, The	USAEPG, Fort Huachuca, Ariz.
California Institute of Technology	USAERDL, Fort Belvoir, Va.
Jet Propulsion Laboratory	United States Department of Commerce
Canadian Broadcasting Corporation	National Bureau of Standards
Columbia Broadcasting System	Weather Bureau
Consolidated Systems Corporation	United States Department of Interior
Corning Glass Works	Bureau of Commercial Fisheries
CBS Laboratories	Geological Survey
Eastman Kodak Company	United States Information Agency
Ernst Leitz of Canada	United States National Aeronautics
Eye Research Foundation of Bethesda	and Space Administration
Fairchild-Hiller Corporation	Ames Research Center
General Electric Company	Goddard Space Flight Center
General Motors Corporation	Langley Research Center
AC Spark Plug Division	United States Navy
General Precision, Inc. (Link Group)	Naval Air Development Center
Georgia, State Dept. of Education	Navy Electronics Laboratory
Giannini Controls Corporation	Marine Engineering Laboratories
Houston Fearless Corporation	Naval Photo Center
Hughes Aircraft Company	Naval Research Laboratory
IBM Corporation	Naval Ordnance Test Station,
International Telephone & Telegraph	China Lake
LTV Temco	University of Arizona
Macbeth Corporation	University of California
Mayo Foundation	Berkeley
Metro Goldwyn Mayer Inc.	La Jolla
Minnesota Mining & Manufacturing Co.	Lawrence Radiation Laboratory
National Broadcasting Corporation	University of Indiana Medical Center
National Film Board of Canada	University of North Carolina
North American Philips Company	University of Pennsylvania
Philco Corporation	University of Rochester
Pittsburgh Plate Glass Company	Varian Associates
Radio Corporation of America	Washington University
Broadcast & Communications Div.	Westinghouse Electric Corporation
Raytheon Company	Xerox Corporation
Rochester Institute of Technology	
Sanders Associates	
Stanford University	
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Technicolor Corporation	
Tektronix	
Telesistema Mexico	



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PRICE AND DELIVERY SHEET

May 15, 1965

PHOTOMETERS

700L	Log Linear Photometer. Metal case, complete with calibrated photomultiplier & regulated AC power supply.	Stock - 30 day	\$780.00
700M	Log Linear Photometer. With battery power supply, in ruggedized Formica carrying case, Malacca Teak finish, complete with calibrated photomultiplier.	Stock - 30 day	760.00
700M	With regulated AC power supply instead of batteries.	Stock - 30 day	780.00
721L	Linear Photometer. Metal case complete with photomultiplier and regulated AC power supply.	Stock - 30 day	680.00
721M	Linear Photometer. With battery power supply in ruggedized Formica carrying case, Malacca Teak finish complete with photomultiplier.	Stock - 30 day	660.00
721M	With regulated AC power supply instead of batteries.	Stock - 30 day	680.00

PHOTOMETER ACCESSORIES FOR 700L, 700M, 721L AND 721M

700-1	General Purpose Photomultiplier Housing.	Stock - 30 day	55.00
700-1-2	Matched Neutral Density Filter Set for use with General Purpose Housing with or without photopic correction .5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0 log attenuation.	Stock - 30 day	135.00
700-2	Photometric Telescope (with apertures).	Stock - 30 day	50.00
700-3B	36" Fiber Optics Probe, 1/8" diameter.	Stock - 30 day	65.00
700-4	Cosine Receptor Incident Light Housing (footcandle head)	Stock - 30 day	95.00
700-5	Monochromator Housing.	Stock - 30 day	165.00
700-6	Regulated AC Power Supply.	Stock - 30 day	90.00
700-7	Battery Pack.	Stock - 30 day	70.00
700-8	Miniature Cosine Head couples to 700-3B Fiber Optics Probe.	Stock - 30 day	55.00
700-9	Calibration Mask (footlambert to footcandle converter) for 700-4 Cosine Receptor from 220-1 Luminance Standard Head.	Stock - 30 day	20.00
700-11	General Purpose Housing to Microscope Adaptor.	Stock - 30 day	30.00
700-15	Standard of Reflectance.	Stock - 30 day	45.00
700-16	Precision Photometric Telescope with 60 mm. dia. objective and one aperture from 6 minutes to 2 degrees.with 1 or 3 minute aperture.	Stock - 30 day	400.00
		Stock - 30 day	425.00
700-20	Scale Expander.	Stock - 30 day	300.00

CALIBRATION EQUIPMENT

201	Luminance Reference (battery operated).	Stock - 45 day \$150.00
220	Standard Lamp Source.	Stock - 30 day 410.00
220-1	Luminance Standard Head (100 footlambert head). With elapsed time indicator & precision current monitor.	Stock - 30 day 160.00
220-2	Horizontal Candle Power Head (35 candlepower approx.) With elapsed time indicator & precision current monitor.	Stock - 30 day 115.00
220-3	70 microwatt/steradian/sq. cm. P-11 Head. With total energy calibration.	Stock - 30 day 305.00
P-11	Conversion Filter for 220-1 Luminance Standard Head.	Stock - 30 day 70.00
700-9	Calibration Mask (footlambert to footcandle converter) from 220-1 Luminance Standard Head to 700-4 Cosine Receptor.	Stock - 30 day 20.00

PHOTOMETRIC MICROSCOPE

700-10	Photometric Microscope with X and Y positioning and focusing controls less objective and eyepiece.	Stock - 30 day 375.00
700-10-1	Photometric Microscope with vernier focusing control but no X or Y positioning control.	Stock - 30 day 145.00
700-10-3	Adjustable Microscope Stand.	Stock - 30 day 97.00

Microscope Eyepieces

700-10-35	Ten power focusing eyepiece with .012", .027", .06" dia. fiber (specify) with .002" or .006" fiber (specify)	Stock - 30 day 125.00 Stock - 30 day 140.00
700-10-25	Scanning micrometer eyepiece with .012", .027" or .06" fiber (specify) with .002 or .006" fiber (specify)	Stock - 30 day 295.00 Stock - 30 day 305.00
700-10-25-1	Coupled Electrical Position Transducer (10 turn precision potentiometer) for scanning micrometer eyepiece.	Stock - 30 day 50.00

Microscope Objectives

Gamma Scientific Part No.	Power	Numerical Aperture	Free Working Distance (Lens to work)	Price
700-10-4	2.5	.03-.25*	2 1/4"	195.00
700-10-5	2.5	.1	2 1/4"	25.00
700-10-6	4	.1	3/4"	25.00
700-10-7	10	.25	1/4"	25.00
700-10-8	40	.65	.02"	72.00
700-10-9 oil immersion	100	1.25	.1 mm	295.00
700-10-10	20	.40	.20	40.00
700-10-11	5	.18	3/4"	75.00
700-10-12 Cassegrain Reflector for UV & IR	15	.28	1"	450.00

(*) Aperture variable from .03 to .25 in 7 steps; also includes removable flare shield.

Prices f.o.b. San Diego
Delivery dates from receipt of order.
Prices & delivery subject to change without notice.



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